Circuit charges supercapacitors to 7V from USB power

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Charging a supercapacitor from a 5V USB port may seem simple at first, but to charge three supercapacitors to 7V and to limit the input current to the 500 mA maximum limit on the USB port is somewhat more difficult. The circuit in this Design Idea uses a Linear Technology (www.linear.com) LTC3458 switching regulator to charge three series-connected supercapacitors and provide input-current limiting. This regulator limits the input current, as the capacitors charge, to less than 500 mA to satisfy USB specifications, and it provides the boost function to charge the capacitor to a voltage greater than the 5V USB input. Once the supercapacitor charges, the regulator maintains 7V at the output and can supply a continuous load of approximately 300 mA in addition to brief current surges of several amperes without exceeding 500 mA at the input. Typical loads requiring high surge current can include motors when initially starting up.

Removing the input voltage shuts down the regulator and reduces the capacitors' discharge current to approximately 3 μA, essentially the current through the voltage programming resistors. Manual shutdown is also possible by pulling the shutdown pin low, but, with the input voltage still applied, the capacitors' discharge current increases to approximately 30 μA. The circuit in **Figure 1** is programmed for a switching frequency of 1 MHz with an output voltage of 7V. A resistor on

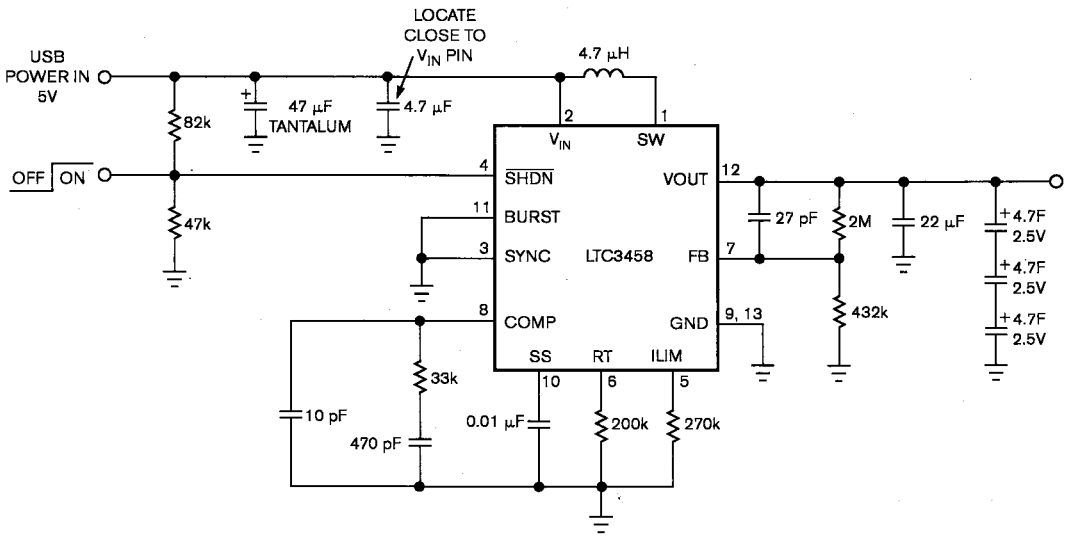

Figure 1 This circuit has a switching frequency of 1 MHz and an output voltage of 7V.

the current-limiting pin, ILIM, sets the input-current limit. The circuit contains all surface-mount components, and the high switching frequency allows the use of tiny inductors and capacitors, thus reducing total circuit size. You should use good PCB (printed-circuit-board)-layout practices.

The series-connected Polystor aerogel supercapacitors, available from various online sources, are each rated at 4.7F at 2.5V and feature a typical ESR (equivalent-series resistance) of 25 mΩ, thus allowing high discharge current. Low leakage current provides long capacitor-voltage-holdup time. The individual capacitor voltages track within 100 mV when charging and charge completely in less than 60 seconds at the rated charge current. Figure 2 shows the capacitors' voltage, charge current, and resulting current drawn from the USB port when charging. EDN

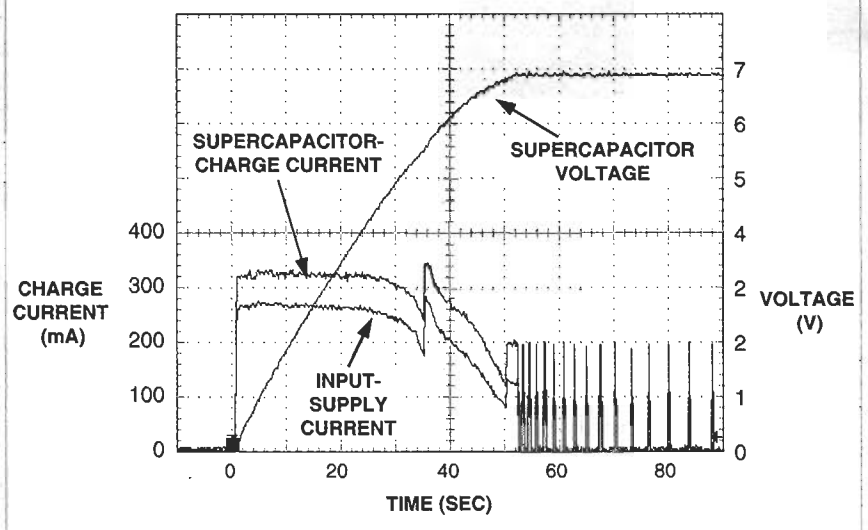

Figure 2 These curves show the super capacitors' voltage and charge current. Note that the charging current is 300 mA—the USB maximum allowable current draw.